

Lessons Learned Organizing the PAM 2020 Virtual Conference

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ABSTRACT

Due to the COVID-19 pandemic, the organizing committee of the 2020 edition of the Passive and Active Measurement (PAM) conference decided to organize it as a *virtual* event. Unfortunately, little is known about designing and organizing virtual academic conferences in the networking domain and their impacts on the participants' experience. In this editorial note, we first provide challenges and rationale for various organizational decisions we made in designing the virtual format of PAM 2020. We then illustrate the key results from a questionnaire-based survey of participants' experience showing that, while virtual conferences have the potential to broaden participation and strengthen focus on technical content, they face serious challenges in promoting social interactions and broadening the scope of discussions. We conclude with key takeaways, lessons learned, and suggestions for future virtual conferences distilled from this experience.

CCS CONCEPTS

• **Social and professional topics** → *Professional topics*;

KEYWORDS

Virtual Conference Organization, COVID-19, Participant Experience

1 INTRODUCTION

The *Passive and Active Measurement* (PAM) conference has brought together researchers and practitioners to discuss network and systems measurements and analysis since 1999—initially as a workshop and since 2006 as a conference. The 2020 edition of the conference was to be held at the University of Oregon in Eugene, Oregon, U.S., on March 30 and 31 of 2020¹.

¹Ramakrishnan Durairajan and Reza Rejaie served as general chairs, whereas Anna Sperotto and Alberto Dainotti served as program chairs. Chris Misa acted as presentation chair (a new role we found needed in a virtual conference). Oliver Hohlfeld and Dennis Guse led the effort of carrying out a survey among participants.

In early March, the news about the COVID-19 outbreak became increasingly alarming though international and domestic travel was still ongoing. On March 5th, after careful consideration, and in agreement with the steering committee and the program chairs, the PAM general chairs notified the community that the conference would be organized as a virtual meeting—attendees would participate remotely. This decision was primarily made to protect the health and safety of PAM participants as well as the local host community. Within the remaining 25 days, the general chairs canceled all planned arrangements for the in-person conference and—together with the program chairs and various members of the organizing team—arranged a virtual conference. At the beginning of March, we could rely only on our intuition of the best course of action, and on our determination to leave enough time to prepare a successful online event. In retrospective, we know that it was a good call: a couple of weeks later, several countries and various states in the U.S. (including Oregon) banned all in-person events and gatherings to “flatten the curve”.

In this editorial, we report on our experience in organizing this event, which, to the best of our knowledge, was the first academic conference on networking entirely organized as a virtual meeting. Since then, other conferences followed [14, 11, 13, 6] and discussions emerged in the research community about virtual conferences becoming the norm in the future [10, 15]. Yet, little is known about how to design virtual conferences and how they impact the participants' experience. Given the growing interest in virtual conferences, we aim to provide insight for organizing similar events in the future and to inform and inspire an ongoing conversation around how the networking research community can leverage the opportunities offered by virtual conferencing while minimizing the associated drawbacks.

First, in Section 2, we discuss in detail the format and various organizational aspects we opted for, provide the rationale behind these decisions, and describe how they played out during the actual conference. Next, in Section 3, we present the methodology and

analysis of our questionnaire-based study of PAM 2020 participant experience. At a high level, the results of this study indicate that, while virtual conferences have the potential to broaden participation and strengthen focus on technical content, they face serious challenges in promoting social interactions and broadening the scope of discussions. We conclude the paper in Section 4 with a reflection on lessons learned and the possibilities for future virtual conferences.

2 ORGANIZING A VIRTUAL CONFERENCE

The single-track program for PAM 2020 consisted of a keynote presentation, 19 papers, and 5 posters that were scheduled² over a two-day window. In the absence of any prior exclusively-online networking conference to use as a reference, we made a set of decisions to reorganize the format to suit the online setting. Our decisions were driven by two main goals: *i*) making the experience as useful and positive as possible for participants and presenters and *ii*) minimizing the risks associated with technical, social, and other unknown factors.

Conference Format Overview. We converged on the following conference format: *i*) playing pre-recorded videos of presentations, *ii*) having an interactive question-and-answer period after each video presentation, *iii*) adjusting the program order based on each presenter’s time zone, and *iv*) creating a “virtual-hallway” for facilitating offline discussions among participants and authors.

Conferencing Platform. We identified the following features as desired in a conferencing platform: *i*) supporting a large group of participants, *ii*) providing a chat feature for private and public messages, *iii*) offering the ability to playback a pre-recorded video, *iv*) supporting the ability to record a session, *v*) accommodating multi-platform support (including mobile phones), and *vi*) allowing world-wide usage. After examination of a few popular conference platforms, we opted for Zoom³, since it offered many of our desired features and most of us had already used it for a significant time, finding it reliable and intuitive to use. We emailed instructions and credentials for the main conference Zoom sessions to all registered participants. Note that this information could have been shared with others, allowing other non-registered participants to join the session. Zoom offers ways to control session participants and prevent unintended access, but we did not perform any explicit check on participant identities. Nevertheless, there were no visible incidents of “zoombombing” or unauthorized access.

Recorded Presentations. We asked all presenters to record their presentation to replay during the conference, instead of having a live presentation, for the following reasons: *i*) to mitigate the impact of technical issues that could prevent smooth presentations or introduce delay in the program, *ii*) to avoid the possibility that a presenter may not show up online or experience connectivity issues at the time of their presentation, *iii*) to minimize the potential negative effect of giving an online presentation (as a new experience and without any sense of audience), and *iv*) to better control the duration of talks in a virtual setting (without the visual cues used in person). Given that questions or interruptions are not common during conference presentations, we concluded that playing back

the video would not affect the experience of participants and would be a safer and preferred option for presenters. While this solution worked well for paper presentations, we later realized it was sub-optimal for the invited keynote talk, since it lacked the opportunity to interact with the speaker during her (longer) presentation. Finally, having pre-recorded talks allowed us to publish the videos online very soon after the conference—which was appreciated by the participants and maximized research exposure.

Presentation Chair. We provided detailed instructions for presenters⁴ on how to prepare and share their presentation videos with us and quickly realized that we needed to designate a *presentation chair* to curate the presentation videos. This role was taken by Chris Misa, a PhD student at University of Oregon. The presentation chair examined all the videos to ensure their duration, clarity, and quality, and assisted the chairs in getting back to the presenters to solve minor issues. During the conference, the presentation chair was the host of the Zoom session and managed playback of the videos in close coordination with session chairs, to whom he assigned co-host privileges. After the conference, he converted and placed all the videos on YouTube, and linked them to the technical program.

Question & Answer. We asked all presenters to make themselves available at the end of the playback of their video for an interactive Q&A period. Each presenter was instructed to *check in* with their session chair through a private Zoom message. At the end of each presentation video, the session chair controlled the floor (as Zoom co-host), encouraging and managing questions between participants and the presenter. We also had cases where several participants jumped into a discussion to comment on a question or answer. All the presenters showed up on time and answered all the questions received during the Zoom session.

“Virtual Hallway” Interactions. In some cases, the presenters and participants continued their discussion after the session (*e.g.*, during the break using virtual hallway interactions). We actively used Slack⁵ for all sorts of interactions and coordination among different groups of participants during the conference. In particular, to support a “virtual hallway track”, we asked all participants to join two public Slack channels: *i*) a general channel for broadcasting any announcement related to the conference, and *ii*) a separate channel for each session of the program (and one for posters). Several presenters and participants used per-session channels to post further questions, explanations, tools released, and further results. Overall, these Slack channels offered an effective way for participants to exchange information, but lacked the social elements associated with in person hallway interactions.

Coordination During the Conference. We also set up a separate Slack channel for all conference organizers—the TPC chairs, general chairs, all session chairs, and most importantly the presentation chair—to effectively coordinate and address issues during the conference. This channel was used for “behind the scene” coordination (*e.g.*, when to start a session, when to play a new video, addressing any issues with the video during playback) and was closely monitored by all team members throughout the conference. The TPC chairs and general chairs used yet another Slack channel

²<https://pam2020.cs.uoregon.edu/Program.html>

³<https://zoom.us/>

⁴<https://pam2020.cs.uoregon.edu/Instructions.html>

⁵<https://slack.com/>

to coordinate various conference-related issues before, during, and after the conference.

Role of Session Chairs. The virtual nature of the conference made the job of session chairs more difficult, as they needed to stay on top of all events while coordinating with others to ensure a successful virtual session. We established a simple protocol with sessions chairs a few days before the conference, which consisted of the following steps: *i*) coordinating with the presentation chair and other organizers before starting the session, *ii*) coordinating with presenters to make sure they were available for the Q&A session of their paper, *iii*) introducing individual presenters and prompting the presentation chair to start the video, *iv*) inviting questions at the end of each presentation, ensuring that the presenter is online, and coordinating the Q&A based on the questions posted in the chat, *v*) muting the microphone of any participant that might generate background noise during a talk, and *vi*) providing feedback for the presentation chair to adjust the volume of audio or any other aspects of the video. The session chairs were given co-host privileges during their session to effectively manage these tasks and we ensured that all of them were comfortable with Zoom and its features.

Accommodating Different Time Zones. With participants spread across the whole world, identifying a timezone convenient for everybody was challenging if not impossible. Given the short time we had available to re-organize the conference, we chose to stick to the timezone of the hosting organization (US Pacific Coast time), *e.g.*, to not ask students to work outside the regular hours. However, we asked the presenters to provide their home timezone and which sessions they would *not* be able to join. Based on this information, the TPC chairs adjusted the program to accommodate these constraints while maintaining the coherency of the papers with each session's theme.

Poster Session. Our original plan for the on-site conference was to hold poster sessions in the conference hallway during lunch breaks and in the afternoon before the social event. For the virtual conference, we reorganized the poster session as individual poster presentations (5-minute talk + 1 min Q&A) during the slots originally allocated for lunch breaks. Nevertheless, these sessions saw a significant attendance (>30 participants each day).

Registration Fees. The registration fees were significantly reduced: from USD350 to USD50 for students and from USD450 to USD100 for a standard registration. The collected registration fees were used to cover the anticipated cost of any software, services, and personnel for preparing the content and managing conference sessions. The difference in registration fees was immediately refunded to those participants who had registered earlier and paid in-person registration fees. We received a few emails from participants in support of our decisions. One participant decided to not join the virtual conference due to the timezone difference. They were fully refunded despite our stated policy of registration being non-refundable. A few participants even informed us that they planned to join the virtual conference while they would have been unable to attend the physical conference.

Acknowledging Sponsors. We listed our sponsors—Verizon, Comcast, and Akamai—and the hosting university on the conference web site as usual. However, to make sure that our sponsors and host organization were properly acknowledged we took the following additional steps. *i*) We shared a slide template with the sponsors' ACM SIGCOMM Computer Communication Review

logos in the footing that was used by many authors. *ii*) We created images with the PAM 2020 and sponsors' logos and shared them with all organizers (the TPC, general, and session chairs) to use as their virtual background on Zoom. *iii*) We created inter-video slides with the same logos, inserted by the presentation chair between video presentations, during Q&A sessions, and during breaks.

Scientific Dissemination. We linked all content produced for the conference to the technical program web page⁶. This includes a copy of the papers hosted at the respective authors' web sites, presentation slides, and links to the presentation videos hosted on YouTube⁷. We explicitly requested presenters' consent before publicly posting their videos on YouTube.

Curating/Playing Back Presentation Videos. Our presentation chair used VLC player [1] for playing back all videos, both for testing and during the conference. The entire conference (including the inter-video slides as JPEG files with a duration of 10s) was organized into an xspf playlist [2]. We ended up editing this playlist a couple of times and replicated it on multiple servers for backup in case of a failure during the conference. The media files were also copied to another shared storage, so that the general chairs could play the videos in case the presentation chair became unavailable during the conference.

The presentation chair went through the following steps for each provided video: *i*) watching the first minute and last minute of the video to ensure acceptable video and audio quality as well as video-audio synchronization,⁸ *ii*) re-encoding videos to a bit rate that played reliably on the presentation chair's computer, and *iii*) running each video through ffmpeg-normalize [3] to normalize audio channels.⁹ For some presentations, however, we still found it useful to manually adjust the volume during the conference.

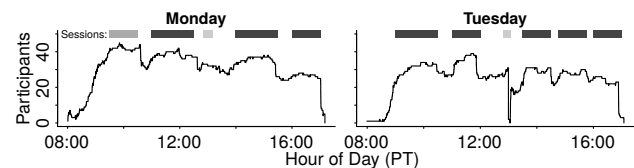


Figure 1: Number of Zoom participants over time.

Participation. We show the number of participants in the Zoom livestream in Figure 1 with session boundaries shown along the top. The figure shows a decline in participation in both days towards the end of the day—an effect that might be a consequence of timezone differences. On the second day we experienced a short Zoom outage around 1 PM PT, which lasted about 1 minute. We note that, while participants often do come and go in normal in-person conferences, the virtual format allows greater precision in tracking participation.

3 PARTICIPANT EXPERIENCE

Organizing PAM 2020 as a virtual conference provided an opportunity to assess the impact of a virtual event on its participants. To this end, we employed a questionnaire-based approach to collect

⁶<https://pam2020.cs.uoregon.edu/Program.html>

⁷<https://pam2020.cs.uoregon.edu/videos>

⁸One author originally submitted a PowerPoint Show file which did not render properly on the presentation chair's computer, leading to followup and re-submission.

⁹The default EBU R128 normalization strategy [5] with a target loudness of -5 dB/LUFS was used.

information from PAM participants. We make the collected data and all the resulting analysis publicly available at [9].

3.1 Survey Methodology

We designed and administered two online questionnaires—one before and one after the conference—to PAM participants [12].

Pre-Conference Questionnaire. This questionnaire focused on planned attendance at PAM 2020 and the expectations of participants by gathering data on the following topics: *i*) participant information (time zone, seniority, number of previously-attended PAM (on-site) conferences), *ii*) planned participation, *iii*) technical and social goals for attending prior on-site editions of the PAM conference, and *iv*) goals for attending this virtual PAM conference.

Post-Conference Questionnaire. The post-conference questionnaire assessed the participants’ experience of attending the conference by collecting the following data: *i*) participant information (same as pre-conference questionnaire), *ii*) experience of attending presentation sessions, *iii*) presentation-related interactions, *iv*) social interactions (e.g., virtual hallway track), *v*) overall experience and fulfillment of expectations, and *vi*) general comments about virtual attendance and suggestions for future virtual conferences.

Aligning Pre- and Post-Conference Responses. Since our questionnaires were completed anonymously, we could not link the pre- and post-conference responses by individual participants. However, we collect similar “participant information” in both questionnaires, which enables us to meaningfully compare and relate statistics from both questionnaires. In particular, obtaining the number of previously-attended PAM conferences allows us to distinguish the responses from new and returning PAM participants (who are likely to have different expectations and goals) in both pre- and post-conference analysis.

Data Sets and Demographics. Our pre-conference (post-conference) questionnaire was answered by 31 (28) participants. Table 1 presents the demographics as well as prior attendance of PAM among respondents in pre- and post-conference questionnaires, respectively. 68% (57%) of the pre-conference (post-conference) respondents attended PAM for the first time. Ph.D. students are the largest group among the first-time participants in both questionnaires and make up roughly half of this group. The returning PAM participants are mostly comprised of faculty and industry professionals. Note that the total number of respondents and their breakdown across different professional categories (3rd and 6th row of Table 1) in both questionnaires are very similar leading us to assume that the population of respondents to both questionnaires are similar.

As we intuitively assume participants in close professional categories to have similar objectives in attending the conference, we present results by merging participants into the following three broader categories: (1) “government scientist” and “Industry”, (2) “Postdoc” and “Faculty”, and (3) “Masters” and “PhD” students.

The break down of the most popular time zones across pre-conference respondents are as follows: 29% in the Pacific Time zone (UTC -7) as the program time zone, 22.6% in Eastern Time (UTC -4), and 32.3% in Europe (UTC +1). 6.5% of the respondents experienced the longest time zone difference (UTC +8).

3.2 Pre-Conference Expectations

This subsection presents our analysis based on the data collected from the pre-conference questionnaires.

Planned Participation. 39% of respondents indicated that they would have not attended the on-site PAM. Interestingly, the demographics of these *virtual-only* respondents are generally similar to other respondents, suggesting that the virtual format can expand a conference’s accessibility without facilitating a specific category of participants. However, 61% of respondents indicated that they would have attended more sessions in an on-site conference. Surprisingly, this pattern seems to be unrelated to time zone—for example 67% of respondents from the Pacific Time Zone (the conference time zone) stated that they would have attended more sessions in an on-site conference. Also, an absolute majority of participants indicated that they were planning to use the virtual hallway track to interact with others and actively engage in the conference—specifically, 61% answered positively, while 36% were uncertain, and only 3% did not plan to utilize the virtual hallway at all and only watch the video stream.

Goals For Attending On-Site vs Virtual Conference. We asked participants about four different goals for attending PAM 2020 as a virtual conference compared with if it would have been held on-site. The plots in Figure 2a and Figure 2b present the importance of each goal for both settings (virtual and on-site) using a 5-point Likert scale across the three (merged) categories of participants. These plots highlight a few key points. First, the importance of presenting research in an on-site format is *extremely high*, *high*, and *low* among students, faculty/postdocs, and industry/government groups, respectively. However, when compared to virtual formats, the importance of presenting research remains the same only for students while it decreases (by 11-22%) for the other two groups.

Second, in the on-site format, following the presentations is moderately important to participants in all groups. However, this goal becomes slightly (10-15%) more important in the virtual format only for students and faculty/postdocs.

Third, interestingly, interacting with known researchers in the on-site format is very or extremely important for 69%, 100%, and 56% of students, faculty/postdocs, and industry/government participants, respectively. As might be expected, all three groups—in particular faculty/postdocs—clearly lower their expectations for this goal in the virtual format.

Fourth, meeting new researchers is very or extremely important for a significant majority (89-92%) of students and faculty/postdocs and 67% of industry/government participants in the on-site format. The importance of this goal drops by 20-30% across all groups in the virtual format.

Takeaway: *Virtual conferences have the potential to broaden participation across all groups of participants that otherwise would not have joined the on-site edition. While time zone differences did not largely impact the planned participation, participants of all professions indicated they would have attended more sessions on-site. In subjects for whom the most relevant goal in conference attendance is social interaction, this relevance decreases significantly for a virtual version of this conference.*

Questionnaire	# of PAMs	Responses	Faculty	Gov. Scientist	Industry	PhD	Postdoc	Master
Pre-conference	=1	68% (21)	9.5%	4.8%	19.0%	47.6%	9.5%	9.5%
	> 1	32% (10)	40%	0%	40%	10%	10%	0%
	≥ 1	100% (31)	19.4%	3.2%	25.8%	35.5%	9.7%	6.5%
Post-conference	=1	57% (16)	12.5%	6.2%	6.2%	50.0%	12.5%	12.5%
	> 1	43% (12)	33%	0%	33%	17%	17%	0%
	≥ 1	100% (28)	21.4%	3.6%	17.9%	35.7%	14.3%	7.1%

Table 1: Demographics by questionnaire, profession, and the # PAMs attended.

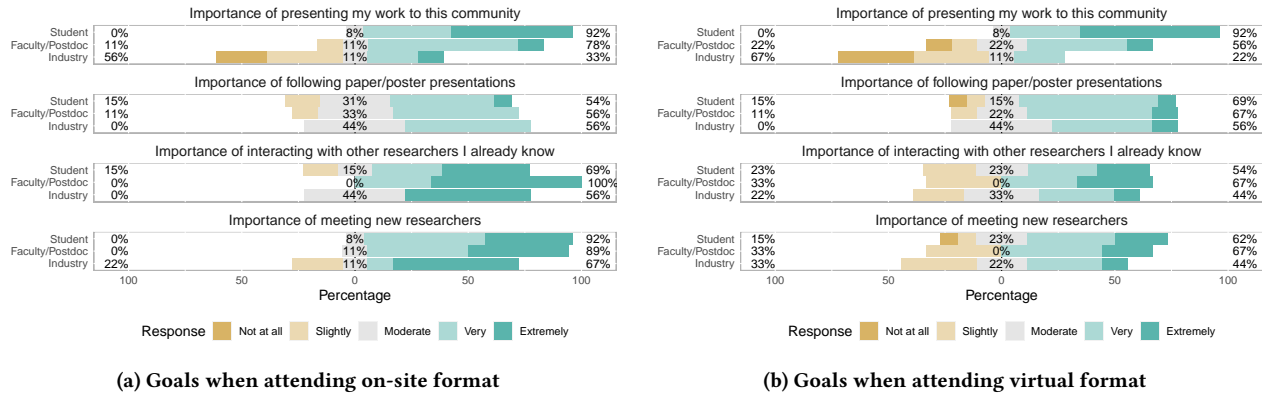


Figure 2: Pre-conference: expressed goals

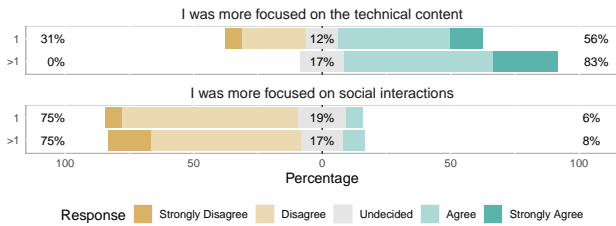


Figure 3: Compared to attending on-site, attending remotely allowed the participants to better focus on the technical content but less on social interactions (by number PAMs attended).

3.3 Post-Conference Experience

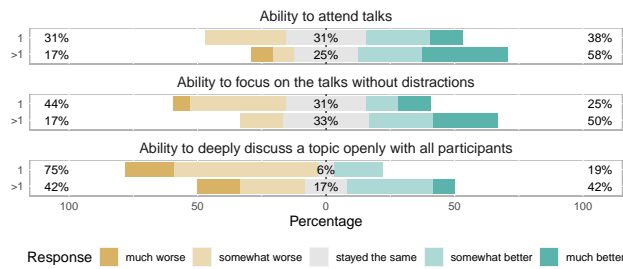
Here we evaluate the participants’ experience based on the data collected from the post-conference questionnaires. Most of our analysis in this section compares respondents based on their (past) participation in PAM, namely *repeating/returning* (>1) vs *new* (1) participants. We remark that the group of new participants contains a high share of Ph.D. students, while the group of repeating participants contains a high share of faculty and industry participants.

Meeting Goals. A large majority of participants found that their pre-conference goals were met by attending the virtual conference—except their expectations for interactions with other participants (other than speakers). Specifically, 75% of new and 67% of returning participants, indicated that they were able to present their research work “as expected”. The ability to follow presentations was perceived as “more than expected” by 58% of the returning PAM participants but as “expected” by 75% of new participants. While

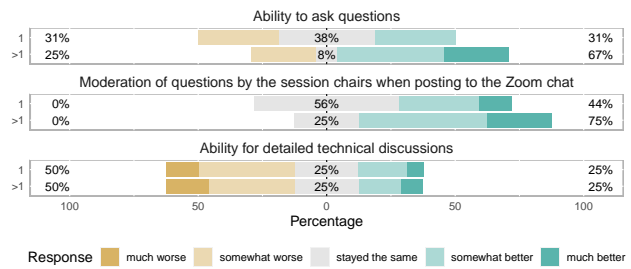
interacting with speakers was generally “as expected”, interacting with other participants was generally “less than expected” for both groups.

Focusing On Technical Content vs. Interaction. Figure 3 shows that both groups of participants agreed that the virtual format allowed them to better focus on the technical content but limited their ability to socially interact. These observations are consistent across all categories of participants (not shown). This is a clear indication that virtual conferences can offer the benefit of improved dissemination of technical content—in principle, the primary objective of a conference. To get a detailed understanding of how participants experienced attending talk sessions, we asked them to explicitly rate factors involving attendance compared to on-site conference (shown in Figure 4a). The top two plots reveal that the repeating PAM participants rated their ability to attend the talks without being distracted much higher than in on-site conferences. In contrast, first-time participants rated their ability to attend the virtual talks roughly the same, but experienced some distractions compared to the on-site format. The latter mostly concerns the group of students, in which 42% indicated the ability to focus without distractions is much or somewhat worse than on-site.

Pre-recorded Talks. The use of pre-recorded talks increased the ability of 32% of participants to follow them, while 54% were neutral, and only 14% of participants reported a limited ability to follow the talks. These results suggest that relying on pre-recorded talks led to a neutral or positive experience for a significant fraction of participants. A possible explanation for this outcome is the fact that pre-recorded talks allow speakers to repeat the recording until they achieve the desired outcome.



(a) Rating of the talk sessions



(b) Rating of talk-related interactions

Figure 4: Rating of talk sessions of this virtual PAM conference compared to on-site (by number of PAMS attended).

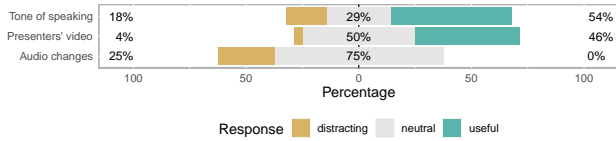


Figure 5: Which one of the following factors during the on-line presentations affected the interest or ability to follow the talk or remain engaged? *i)* Tone of speaking, *ii)* Having a video of the speaker in the corner of slides, or *iii)* Changing of the audio across different segments of the presentation.

We show the impact of three factors that directly affect the ability of all participants to follow online talks in Figure 5. This figure demonstrates that the presenters' tone of speaking and adding the video of the speaker in the corner of slides improved participants' experience, while changes in the presenter's audio (quality) across different segments of the presentation were distracting.

Audio/Video Quality. Audio (Video) impairments never occurred for 18% (21%) of the participants, whereas 54% (57%) of participants experienced audio (video) impairments rarely or very rarely.

Skipped Sessions Due To Time Zones. We asked the participants how many paper sessions they skipped due to time zone differences. The results were similar for all professions: 43% indicate to have attended all technical sessions (excluding poster and keynote), while 1 participant (4%) in Europe attended none due to the difference in time zones. 68% (79%) skipped less than 3 (4). This highlights the fact that time zone differences pose a challenge for scheduling talks.

Presentation-related Interactions. 47% of the participants used Slack or Zoom to actively interact with others on presentation-related topics and 50% passively followed what others wrote—only 4% did not use either. Compared to the reported planned participation from the pre-conference questionnaires, roughly 15% of participants who planned to actively utilize these interactive options ended up using them passively. When using Slack (Zoom) for discussion, 54% (54%) interacted with 1-5 other participants. Overall these results suggest that the offered options for joining the technical discussions were actively or passively used by an absolute majority of participants.

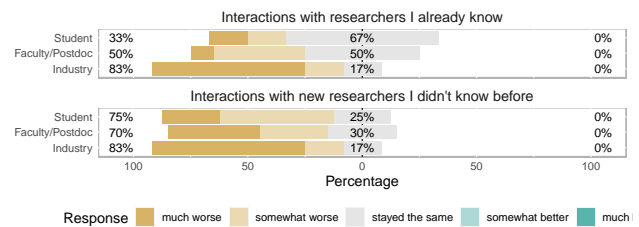


Figure 6: Quality of interactions unrelated to presentations.

We show the rating of the talk-related interactions in Figure 4b. As compared to on-site conferences, asking questions—and in particular the moderation scheme by the session chairs to queue questions in chat (and ask them grouped when feasible)—was perceived as much better. A significant majority of repeating participants (83%) report a higher ability to ask questions than on-site (70% of faculty/postdocs and 50% of the industry, only 33% of students). The rating of first-time participants on the ability to ask questions is rather evenly divided. This suggests that our method of posting questions into the chat box was seen as effective at least by repeating participants. As for the ability to deeply discuss a topic, the assessment of repeating participants' is evenly divided into positive and negative ratings, whereas new participants are mostly (75%) negative. Surprisingly, 60% of the faculty/postdocs rate this better than on-site while only 8% of students and 17% of industry share this opinion.¹⁰

Virtual Hallway Track. While on the one hand the “virtual hallway” mechanism enabled deeper discussion of presentation-related topics, on the other hand, scarcity of social interactions on other, unrelated topics appears to be a weakness of this conference format: 71% of respondents did not use Slack or the Zoom chat to interact with others about topics *unrelated* to the presentations. We show the rating of the quality of social interactions (unrelated to the presentations) during this virtual conference compared to on-site conferences in Figure 6. In-line with prior findings, the virtual setting is rated worse by the majority of participants throughout all professions. We discuss textual feedback on social interactions and suggestions for improvement in Section 3.4.

¹⁰ A notable example involves a discussion on Slack as follow-up to a question during the Q&A that spanned both conference days and involved multiple participants making suggestions for further analysis which were picked up by the speaker, who provided additional evaluations and an additional plot, publicly posted to Slack.

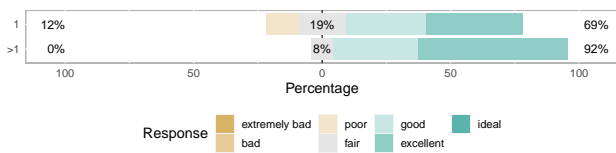


Figure 7: Overall experience by number of PAMs attended.

Overall Experience. The overall experience (see Figure 7) was rated as *good* to *excellent* by 69% of the first time PAM participants and by 92% of the returning PAM participants. This highlights that the virtual conference format worked out well, especially considering the opinion of those that can compare it to prior on-site editions of PAM.

Takeaway: *The virtual conference format allowed most participants to better focus on the technical content and to interact on presentation-related discussions even outside of the sessions. Socializing and expanding technical discussion to other topics did not work well—there is clearly room for improvement on this front.*

3.4 Improving Social Interactions

This section summarizes the positive and negative comments that we received from PAM 2020 participants regarding social interactions along with their suggested improvements.

Positive Aspects. The questionnaire included an optional free text question on “What did you enjoy about social interactions at this virtual conference?” As the results in the previous section reflect, there was clear criticism about social interactions in some responses (e.g., “Useless”, “I hardly interacted”, “There was not really social interactions from my perspective compared to other conferences I’ve been to”, or “Nothing. I felt very lonely during the conference.”). However, there were also *positive* comments about the interactions in the virtual setting (e.g., “It made some interactions easier: no need to wait for another researcher to not be busy to catch them in a hallway—you can simply message them asynchronously.” and “Language is not a barrier because it’s easier to understand written language, no problem with understanding accents”). These comments highlight that communication during a virtual conference reduces “stage fright” and language barriers thus making the interactions less stressful. The virtual format also allowed participants to “continue their main routine/be working/having calls in between or post-sessions” and gave them the possibility to “follow the talks better”. Interacting during sessions did not distract participants from following the presentations. One participant said “It worked better than I expected. I was very impressed.”

Negative Aspects. To identify the negative aspects of interactions, we asked the following optional question with free text response: “Other feedback on *negative* aspects on the ability to interact while participating in PAM 2020.” As can be expected from above, a re-occurring issue in responses was the limited capability for social interactions (e.g., there was no natural way to meet new people, no random interactions at the lunch queue, and there was a virtual barrier to drop messages to a person one never met before). One participant stated that questions remained at a high-level which in turn made it difficult to explore collaboration opportunities. Another participant mentioned that individual poster presentations were

given a very limited time in the virtual format, while the in-person format would have provided multiple windows for all posters to be presented in parallel. It was also mentioned that the limited participation of conference attendees in the Slack channels reduced the opportunity to conduct deeper, multi-threaded discussions.

Suggested Improvements. To collect any suggestion on improving interactions among participants in a virtual conference, the questionnaire also included the following optional, free-text question: “How can social interactions be improved at virtual conferences?” Here we summarize a few collected suggestions that offered interesting ideas. *i)* Facilitating teleconferencing for small groups (e.g., Zoom breakouts) to effectively enable ad-hoc discussions (with selected participants) that instead could be challenging through text messages. *ii)* Speed dating among participants to emulate random encounters between participants in a conference hallway: participants could be paired based on their interests, e.g., collected using a pre-conference questionnaire. *iii)* Arranging open discussion sessions via Zoom to accommodate direct interactions outside the Q&A periods. *iv)* Organizing a virtual dinner, with the possibility to have virtual breakout rooms for 2 or more people to discuss topics of interests or future collaborations.

3.5 General Comments

The post-conference questionnaire also allowed for optional free-text general comments on the conference, which we summarize here.

Pros: What worked well about attending remotely. Among the *pros* of attending a virtual conference, three were repeatedly stated. First, attendees appreciated that no traveling was involved. Second, the lower registration costs coupled with no cost for traveling and lodging were considered clearly positive aspects. Last, several comments pointed to a larger degree of flexibility in organizing themselves during an online event, e.g., allowing participants to combine conference attendance with other work or family related duties.

Cons: What did not work well about attending remotely. Among the aspects reported as less positive in attending a virtual conference, the following three were recurring. First and foremost, several participants commented on the limited opportunities for technical and social interactions with other attendees. Second, several participants mentioned that timezone differences either forced them to skip some part of the conference or caused some difficulties. Last, while the virtual format of a conference clearly enables the participants to control when to “tune in” for their desired presentation, attending the conference as a part of regular routine (e.g., from home) could also lead to distraction.

3.6 Future Virtual Conferences

To assess the interest among participants in attending future virtual conferences, at the end of the post-conference questionnaire—that is, after respondents are supposed to have reflected on various issues (e.g., the talk sessions and conference interactions)—we asked them to what extent they agree/disagree with the following statement: “I would like to attend more virtual conferences in the future”. 14% and 46.5% of the respondents strongly agreed or agreed, respectively; 4% and 14% strongly disagreed or disagreed; and 21.5% were

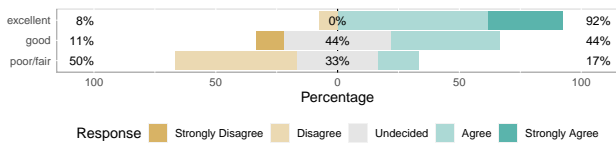


Figure 8: “I would like to attend more virtual conferences in the future” (by overall experience).

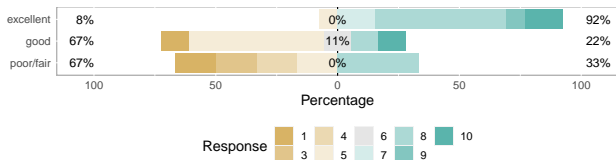


Figure 9: Net Promoter Score: How likely is it that you would recommend attending PAM as virtual conference to a colleague? (0 = 0 Not at all likely to recommend, 10 = Extremely likely to recommend)

undecided. In Figure 8, we break down these answers by the overall rating the respondents gave to PAM 2020 (which is “Excellent” for 47% respondents, “Good” for 32%, and “Poor”/“Fair” for 21%): 92% of participants with “Excellent” overall PAM 2020 rating either agree or strongly agree to attend more virtual conferences in the future (0% are undecided and 8% disagree). These responses indicate a clearly positive tendency to attend future virtual conferences. However, the level of agreement across the three groups monotonically decreases with their overall PAM 2020 rating. That is, the lower the overall experience, the lower the willingness to attend further virtual conferences.

Figure 9 presents responses of participants (again, based on their rating of the virtual PAM) to the following question “How likely is it that you would recommend attending PAM as virtual conference to a colleague?” (*i.e.*, the Net Promoter Score). This figure presents the same overall trend—that is, the better the overall experience at the virtual PAM, the more likely PAM is recommended as a virtual conference in the future.

We remark that both dimensions (*i.e.*, overall experience and future virtual conference attendance) do not have to be correlated, *i.e.*, a participant can consider the online PAM conference as an exception and offer a positive overall rating, but might not be willing to attend or recommend future virtual conferences. However, the above results collectively indicate that there is a clear correlation between user experience at the virtual PAM conference and their interest in future virtual conferences, potentially explainable with this one being their first experience in a virtual conference. To get a better insight in the level of interest in attending future virtual conferences, we asked how many conferences should be held online: 50% of all participants (and 69% of participants with excellent overall experience at PAM 2020) indicated that at least half of the conferences should be virtual. While this topic certainly deserves further exploration, our results offer clear indication of interest in attending future virtual conferences beyond the current situation.

Takeaway: The participants expressed interest in attending future virtual conferences, which appears correlated with their experience with this virtual edition of PAM. This finding suggests that a virtual format should be considered by organizers in the future.

4 CONCLUSION & OUTLOOK

The PAM 2020 all-virtual conference used livestreams for technical content and Q&A as well as textual chats for interaction beyond technical sessions. This format worked well—even better than the traditional *on-site* conference—for disseminating technical content. However, it faced two main challenges: *i)* accommodating timezone is complicated and *ii)* facilitating social interaction is challenging. Future virtual conference need to improve on both aspects to be fully successful.

Many participants indicated that the virtual conference was very well organized and managed and very effective as an online venue. During the conference, it was evident that participants from different countries took advantage of the flexibility offered by virtual attendance to tune in/out of different sessions and talks based on their schedule and interests. Further, many participants indicated that attending such an online conference is very convenient for them (*e.g.*, it fits their budget) and that they would be interested in attending several of such conferences each year.

We note that the issue of difference in time zones exists in both in-person and online conferences for presenters who live far away from the conference venue. For the in-person conference, they have to travel and deal with jet-lag and tiredness from their journey whereas, for an online conference, they might need to make themselves available at atypical hours. Fortunately, an online conference could offer a few more options to ease the time zone issue. For example, while the participants of an in-person conference are likely to appreciate a compact schedule (as few days as possible), the schedule for an online conference could be spread over more days, each limited to a few hours, thus minimizing the timezone issue for a maximum number of participants. Based on our experience, we recommend to future organizers to investigate alternative schedules that take into account the location of both presenters and participants.

In our experience, the design of virtual conferences is currently still tied to the more rigid on-site conference format. Virtual conferences, however, offer substantial flexibility to depart from traditional designs. Examples include: *i)* A hybrid model (online and on-site) in which the dissemination of papers by presentations is held virtually (which appears to work better) and in-depth discussions are held on-site in a “Dagstuhl-like” fashion [4] without planned talks and a focus on breakout sessions and discussion; *ii)* Publishing talk videos before the conference so that participants could pre-watch and focus the interaction on discussions (*e.g.*, brief overview talk, few minutes of authors addressing community questions, longer live Q&A—or other formats); and *iii)* Utilizing new means of social interaction by randomly assigning participants to short 1:1 sessions (like speed-dating) or enabling breakout sessions. In this space, we are seeing the emergence of tools enabling novel ways of facilitating interaction (*e.g.*, along the lines of the Online Town [8] or Mozilla Hubs [7], where proximity in a virtual environment enables audio/video communication) which we intend

and suggest to explore in the future. However, in order to keep focus and limit distractions, the large availability of options and platforms that can be employed in virtual conferences should be balanced with the goal of containing the number of tools used by participants.

Finally, we also learned that an online conference may be gentler on the general chairs in terms of organizing a whole set of logistics (no location, no lunches, accommodation venues, local transportation, traditional social event, *etc.*). However, they still do require substantial effort, such as for curating the video content and effectively managing online sessions. We found that having a capable and tech-savvy person—a role that we defined as “presentation chair”—to prepare the videos and run online sessions is critical for the success of this type of virtual conference.

In conclusion, virtual conferences are a new instrument with which our community still has limited experience and familiarity. Nonetheless, virtual conferences allow for fundamentally new designs, interactions, and benefits. We hope that this report from such an early experience in this space (and arranged within an extremely short time frame), will provide further opportunities for discussion and exploration.

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REFERENCES

- [1] <https://www.videolan.org/vlc/index.html>.
- [2] <https://www.xspf.org/quickstart/>.
- [3] <https://github.com/slhck/fimpeg-normalize>.
- [4] Dagstuhl seminars. <https://dagstuhl.de>.
- [5] Ebu technology & innovation - PLOud. <https://tech.ebu.ch/loudness>.
- [6] Eurosys 2020. <https://www.eurosys2020.org/>.
- [7] Hubs- private social VR in your web browser. <https://hubs.mozilla.com/>.
- [8] Online town. <https://theonline.town/>.
- [9] PAM 2020 questionnaire data. <https://github.com/ohohlfeld/virtual-conference-experience/tree/master/pam2020>, 2020.
- [10] BARRAL, A. Virtual conferences are the future. *Nature Ecology & Evolution* 4, 5 (2020), 666–667.
- [11] BONIFATI, A., GUERRINI, G., LUTZ, C., MARTENS, W., MAZILU, L., PATON, N., SALLES, M. A. V., SCHOLL, M. H., AND ZHOU, Y. Holding a conference online and live due to covid-19. arXiv cs.DB/2004.07668 <https://arxiv.org/abs/2004.07668>, Apr. 2020.
- [12] HOHLFELD, O., AND GUSE, D. A questionnaire to assess virtual conference participation experience. Tech. rep., 2020. <https://github.com/ohohlfeld/virtual-conference-experience/raw/master/questionnaires/techreport/>.
- [13] IOSUP, A., TRUBIANI, C., KOZIOLEK, A., AMARAL, J. N., BONDI, A. B., AND BRUNNERT, A. Flexibility is key in organizing a global professional conference online: The icpe 2020 experience in the covid-19 era. arXiv cs.CY/2005.09085 <https://arxiv.org/abs/2005.09085>, May 2020.
- [14] LARUS, J., CEZE, L., AND STRAUSS, K. The ASPLOS 2020 online conference experience. <https://cacm.acm.org/blogs/blog-cacm/243882-the-aspl0s-2020-online-conference-experience/fulltext>, Mar. 2020.
- [15] PRICE, M. Scientists discover upsides of virtual meetings. *Science* 368, 6490 (2020), 457–458.